

# Electricity Generation – Fuel of Choice?

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# Outline

## Prior to 2001

- Forecasted growth & opportunities
  - ◆ Demand
  - ◆ New projects
    - Natural gas
    - Power

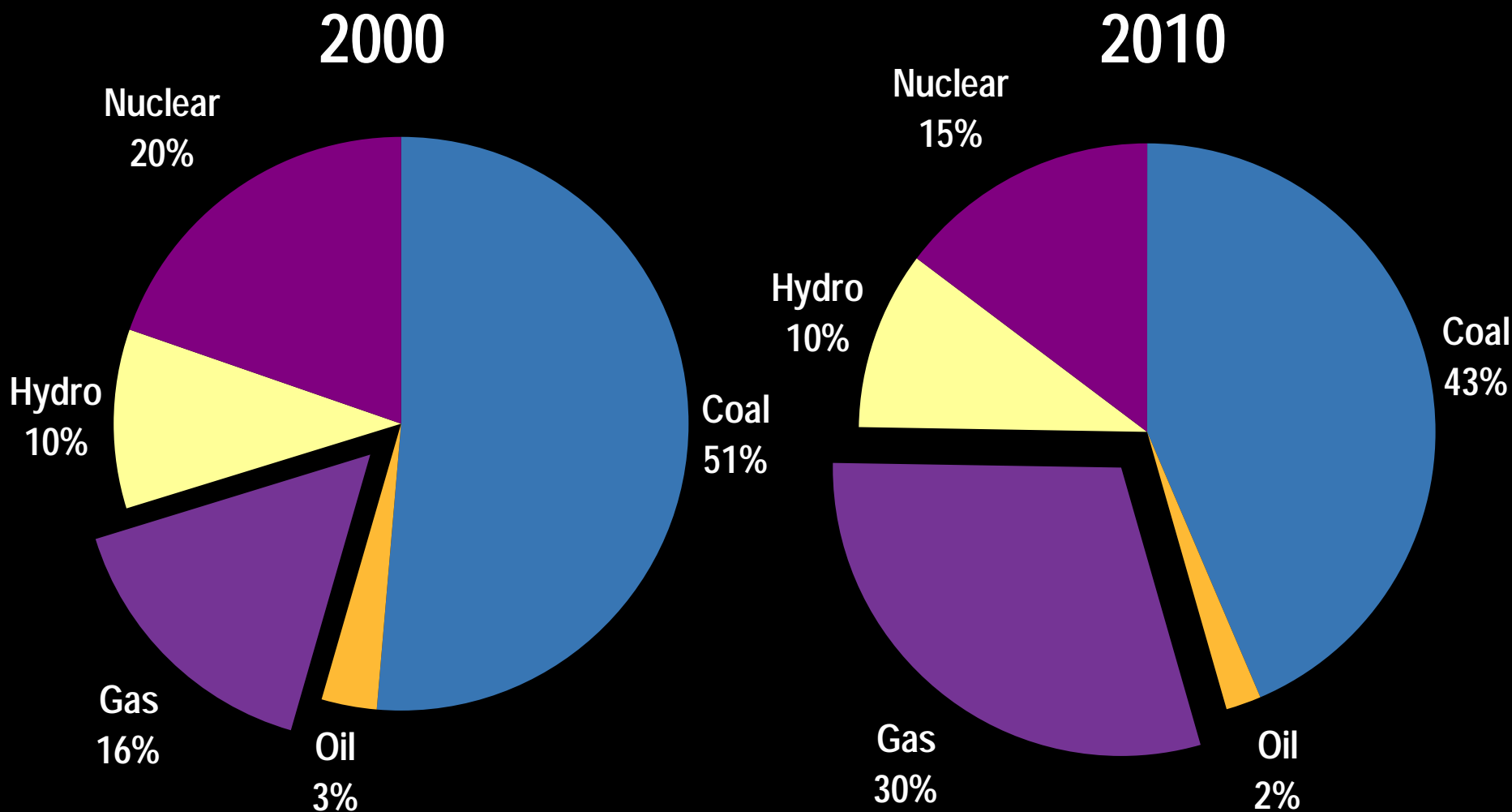
## 2001

- Recent events
  - ◆ Annual demand
- Result – Storage overhang
  - ◆ Price collapse
- Economy & Tragedy
  - ◆ Sept. 11th
  - ◆ Enron situation
  - ◆ Capital spending cuts

## Going Forward

- The Inevitable

# U.S. Power Generation Fuel Mix



# Shifting Portfolio Mix

## ■ Past

- ◆ Pipes themselves
  - Balancing
  - OBAs
- ◆ Storage

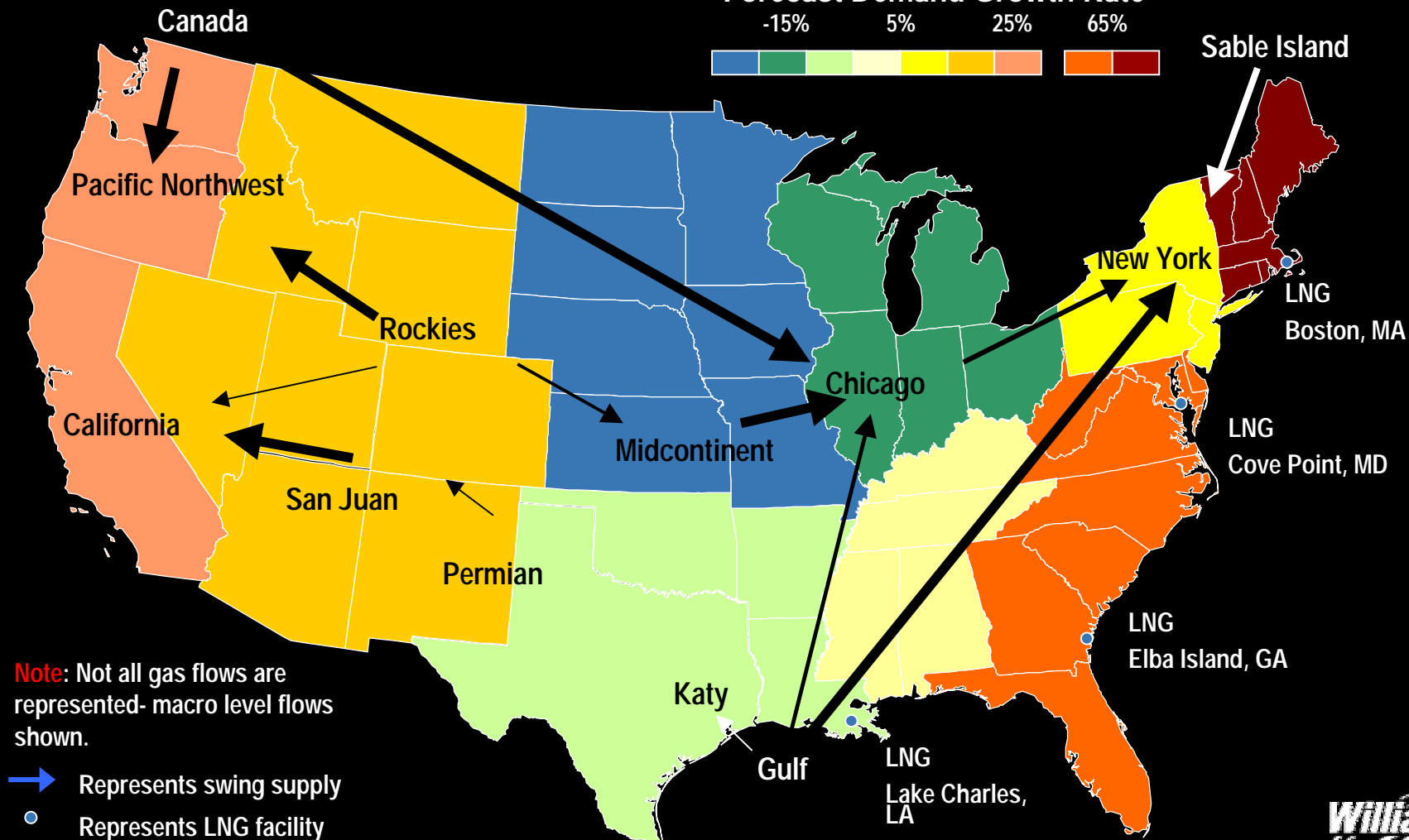
## ■ Future

- ◆ Pipes
- ◆ Storage
- ◆ LNG
- ◆ Fuel switching
- ◆ Demand-side management
- ◆ New technology
- ◆ Hourly gas markets

# Natural Gas Basin Flows & Projected Demand Growth 2002-2006

Forecast Demand Growth Rate

-15% 5% 25% 65%



# North American Gas Forecast

- 2000 North American natural gas demand was approx. 23.3 TCF
- Estimated 2010 demand will rise to 30 TCF (approx. 3% increase per year)
- Drivers:
  - ◆ Environmental regulation
  - ◆ Natural gas-fired power plant construction
- Alternative Fuels

# U.S. Pipeline Additions

## 56+ Bcf/d Announced

### Planning

- 43 projects
- 27.2 Bcf/d
- 11 Bcf/d - 3 AK projects
- In-service 12/01 to 12/08

### Open Season

- 26 projects
- 10.6 Bcf/d
- In-service April 2002 to June 2005

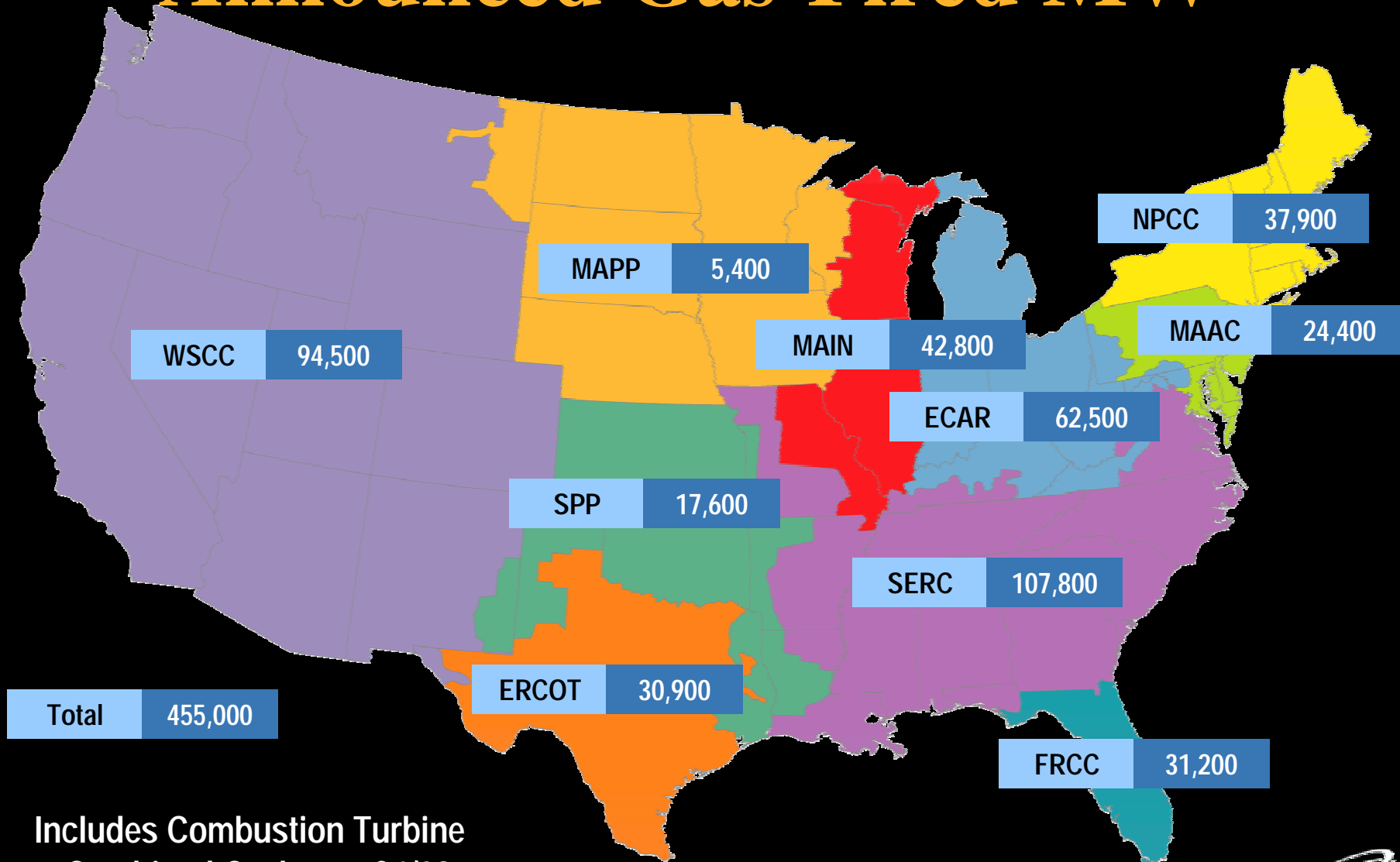
### Filed

- 32 projects
- 7.5 Bcf/d
- In-service Jan 2001 to Nov 2004

### FERC Approved/ Certificated

- 42 projects
- 11.4 Bcf/d
- In-service July 2001 to Nov 2004

# Announced Gas-Fired MW

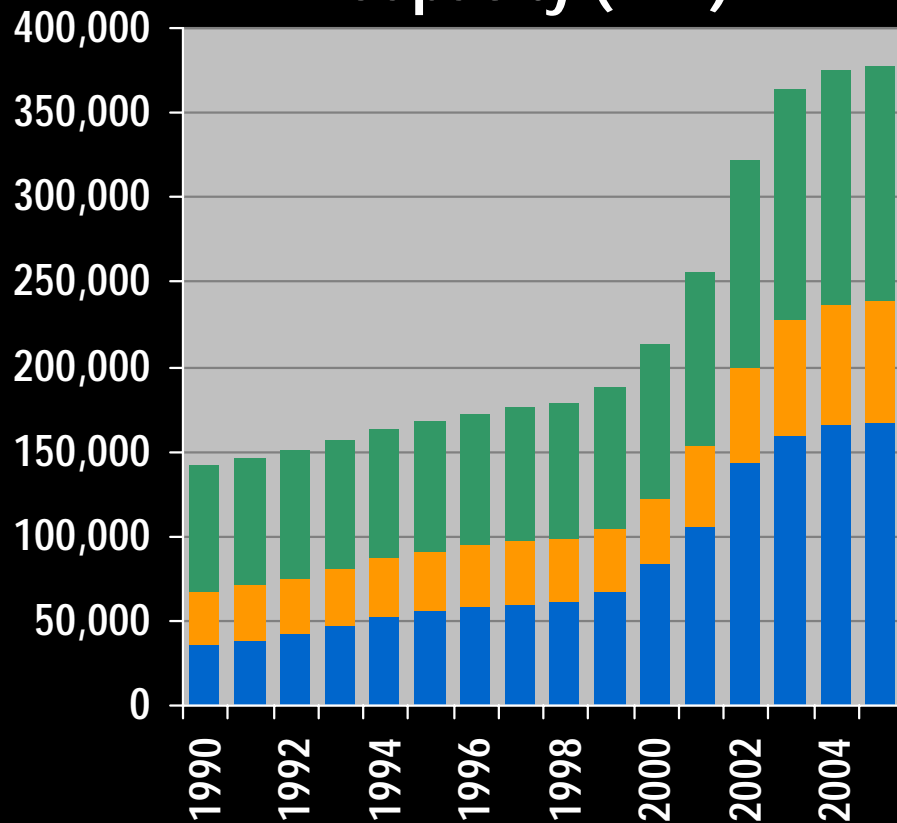


Includes Combustion Turbine  
& Combined Cycle as of 1/02

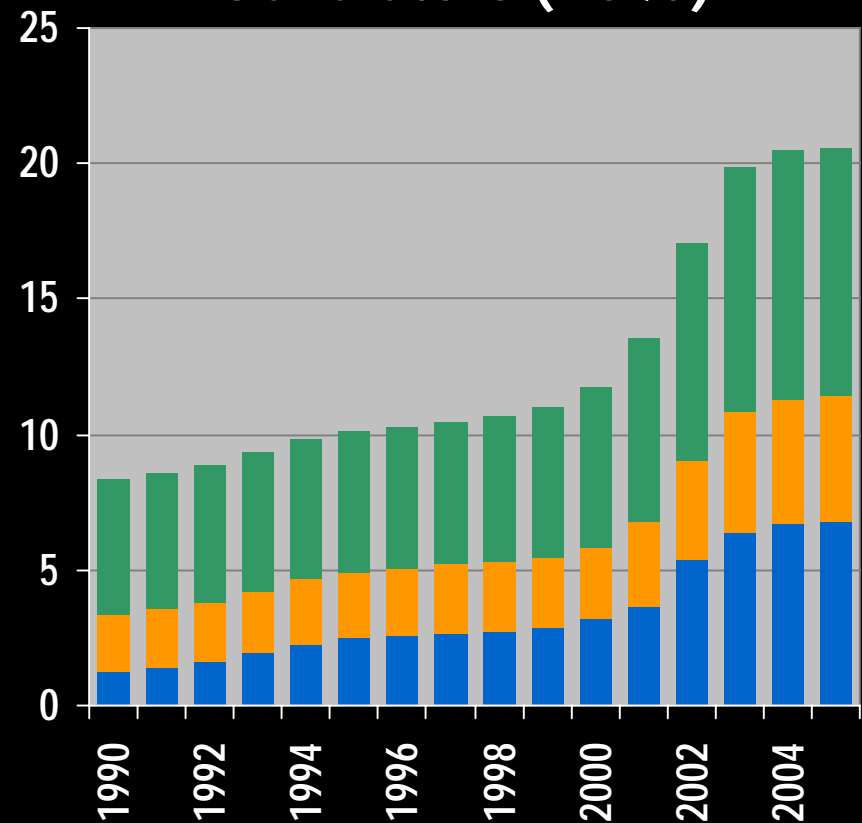


# U.S. Gas-Fired Generation Growth

## Historical & Projected Capacity (MW)



## Yearly Average Burn by Generators (Bcf/d)



Consuming East Consuming West

Producing Region

# Capital Expenditure Cuts

<u>Company</u>	<u>Capex Cut</u>
■ Williams	\$ 1 billion (25%)
■ Calpine	\$ 2 billion
■ Duke	-0-
■ Dynegy	\$ .75 billion*
■ El Paso	\$ 1.5 billion
■ Mirant	\$ 1.5 billion
■ Reliant	-0-
■ Enron	<u>everything</u> (value unknown)
TOTAL	\$ 6.75 billion

\*\*The \$750 million includes capital spending cuts and sale of non-strategic assets.

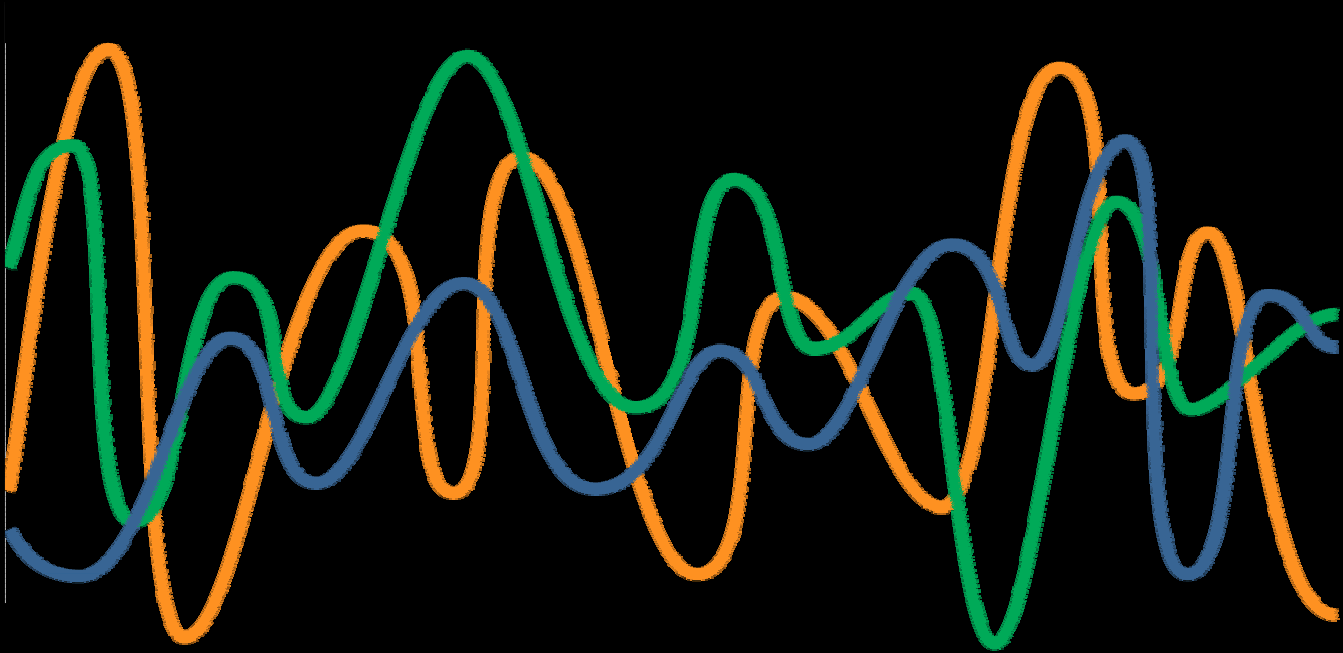
# Economic Indicators

- Capital constraints causing market impact on:
  - ◆ Storage
  - ◆ Pipeline projects
  - ◆ Gas-fired generation
  - ◆ R & D projects

# Delaying the Inevitable

- Capital constraints
- Decreased deliverability of U.S. supply
- Constrained infrastructure
- Impact on pricing

# Volatility



**Will lead to resurgence of alternative fuels**

# Electricity Generation – Fuel of Choice?



# Profile of Coal Plant Least Likely to be Affected by Gas

- Minemouth or Low Delivered Costs
- Low mining costs
- SCR controlled
- Low heat rate
- Gas is the marginal unit most of the time
- High gas transport costs
- Limited gas storage in vicinity
- Area is gas pipeline constrained

# Profile of Plant Most Likely to be Affected by Gas

- High transport costs
- High heat rate
- Abundant gas storage in vicinity
- Low gas transport cost
- Limited or no NOX controls in a region where Nox is regulated



# Gas Will Compete Indirectly

- More gas units will:
  - ◆ Reduce power price spikes
  - ◆ Reduce power prices overall
- Results
  - ◆ Demand growth will be constrained
  - ◆ Asset values of generators may decline
  - ◆ Generators will pay less for commodity
  - ◆ Off-Peak and shoulder months will be most vulnerable

# Competition Will Hasten Wider Industry Changes

- Volatility is here to stay
- Risk management will become more complex
- Transactions will become:
  - ◆ More structured
  - ◆ Multi-commodity
- In Old World, transactions were viewed as Zero Sum Game
- In New World, choice will be between Win-Win and Lose-Lose relationships

# Government Driving Technology

- Solar
- Fuel Cells
- Wind Power
- Geothermal
- Biofuels
- Other Alternatives
  - ◆ Coal emissions trading
  - ◆ Improved efficiencies

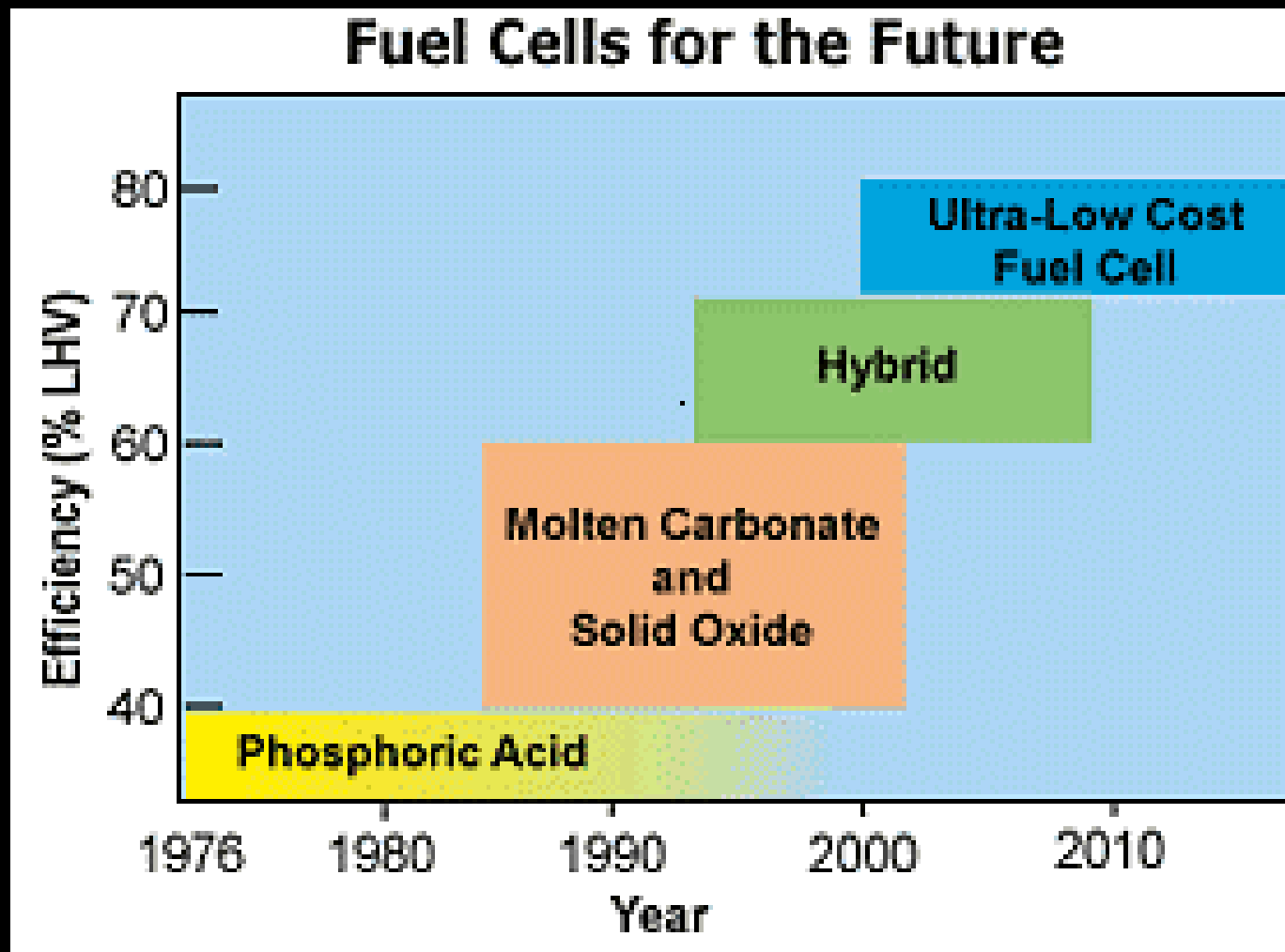
# Distributed Energy Resources Technologies

DER Technologies	Commercially Available	Emerging Technology
Microturbines		
Combustion Turbines		
Reciprocating Engines		
Stirling Engines		
Fuel Cells		
Energy Storage / UPS Systems		
Photovoltaic Systems		
Wind Systems		
Hybrid Systems		

# Costs of DER Equipment

Capital Costs of Selected DER Equipment	
	Capital Cost (\$/kW)
Microturbine	700 - 1100
Combustion Turbine	300 - 1000
ICEngine	300 - 800
Stirling Engine	2,000 - 50,000
Fuel Cell	3,500 - 10,000
Photovoltaic	4,500 - 6,000
Wind Turbine	800 - 3,500

# Fuel Cells



# Conclusions

